U.S. Department of the Interior
U.S. Geological Survey

*The National Map* Catalog Technical Discussion Paper

# Availability of *The National Map* Web Map Services II: 6-Month Report

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# 1 The Catalog Service Checker

The need to quantify Web Map Service (WMS) availability was recognized early in the development of *The National Map* viewers. The deployment of the Catalog in May 2003 made it possible to monitor the WMSs, and the deployment of *The National Map* Catalog-enabled viewer made this monitoring relevant. In July 2003 Jeff Wendel wrote a "service checker."

The checker loops through all the WMSs listed in the Catalog and "pings" each one by issuing an OGC WMS query. If a legal response is received, the system is considered available. If the response is anything other than a legal OGC response (an operating system error, for example), the WMS is considered unavailable. The time of the check, the WMS id number, and the availability status are stored in an Oracle table in the Catalog.

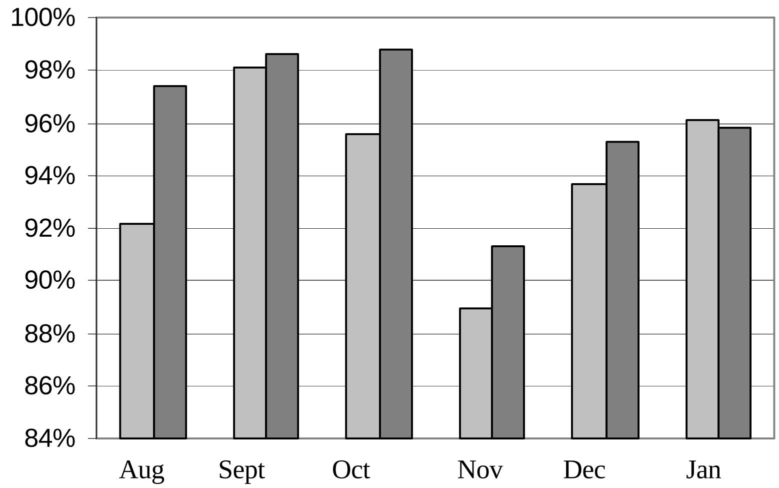


**Figure 1.** Average service availability by month.
Light = mean Dark = median

In September 2003 an internal report summarized the first 50 days of service-check data. That report explained the background technical issues, defined WMS **availability,** and discussed issues of availability in the larger context of the IT industry. This background material is not included in the present report, except for the following brief summary.

Availability is defined for each service as

$$\text{availability} = \frac{\text{'available' data points}}{\text{total data points}}$$

The data used to calculate this value are not continuous; each service is pinged about every 17 minutes. The service checker itself is not 100% reliable, so there are some gaps in the data. However, for time spans of several months enough data points are collected to approximate continuous monitoring.

The basic unit of availability used in this report is one **service-month**, calculated with the above equation for all sample points for one service for one month.

## 2 Disclaimers

The scope of this document is the availability of individual WMSs that contribute data to *The National Map*. Overall reliability of *The National Map* is a much larger issue, affected by many additional factors.

Even within the limited scope of WMS availability, the data presented in this report are not completely clean and unambiguous. The monitoring described here has a number of small technical shortcomings that could affect the accuracy of these data. For example, non-availability of a WMS could be caused by hardware or software failures other than the target WMS. We believe these sources of error are small, and the data in this report are therefore very close approximations of actual WMS availability. However, we do not yet have the data needed to support this belief with valid statistics.

## 3 Results

Overall average availability per month for the 6-month period from August 2003 through January 2004 are summarized in Fig. 1.

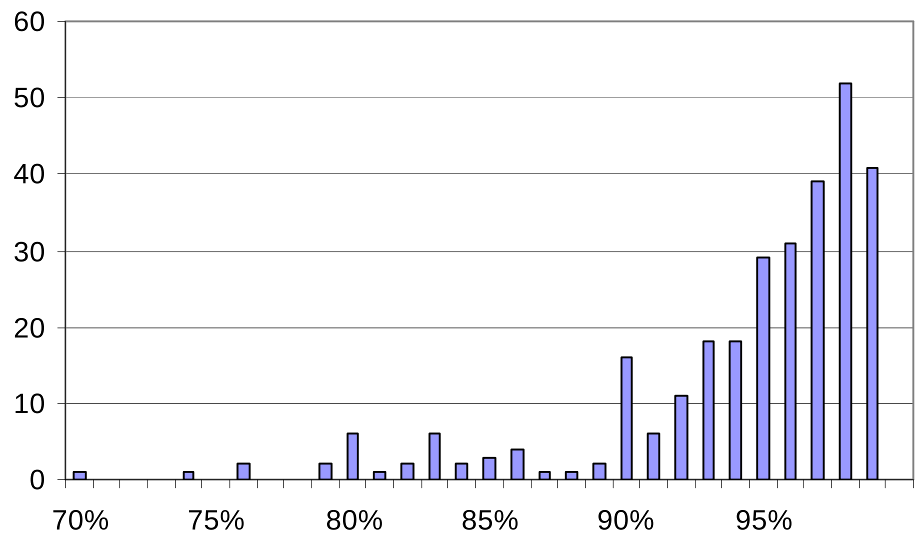


**Figure 2.** Frequency distribution of availability per service-month

Figure 2 is a frequency distribution of service-month availability. The data come from the month columns of Table 1. For example, there are slightly less than 30 service-months with 95% availability (between 95.0 and 96.0).

The following pages contain more detailed summaries of the data in both graphic and tabular form.

# 4 Discussion

At first glance, the numbers presented here may appear acceptable. Most services operate at higher than 90% availability most of the time, and the overall median service-month for a 6-month period is 97%.[1]

But these numbers are actually not very good.

- As discussed in the September version of this report, the canonical availability goal in the electronic communications industry is the "five nines," 99.999%. This is commonly equated to 5.25 **minutes** of downtime per year. 97% availability equates to about 262 **hours** of downtime per year. 262 hours is 3,000 times greater than 5.25 minutes.
- If 65 services (the number of public services feeding *The National Map* at the end of January) all have average availability of 97%, then at any given time the probability that at least two of these services will be unavailable is about 60%. (The statistics of this calculation are explained in the September report.)

99.999% availability may not be a cost-effective goal for such a widely distributed system, but 97% is clearly not a close approximation of 24/7 service. The difference between these figures is more than three orders of magnitude (5.25 minutes vs 262 hours per year), so deciding on a reasonable target goal is rather difficult.

Of course, not all services are equally important. Table 1 highlights two services that are of obvious critical importance to The National Map:

- The Catalog service. If this is down, *The National Map* is down
- The small-scale base layers, such as interstate highways, composed mostly of USGS 100K data. Unavailability of these layers does not technically bring *The National Map* down, but navigating in the viewer becomes so difficult that most users will probably think it is down. To varying degrees, the same is true of all USGS-served national layers.

During the reporting period, these services operated at average availability of 98.5% (down 130 hours per year) and 97.4% (down 227 hours per year) respectively. While better than the overall median, this is not nearly good enough for critical links in *The National Map* system.

Very high levels of availability must depend on automated failover to systems with independent power sources and administration. Such capabilities are being worked on for several critical components of *The National Map*, with varying degrees of success. Examples include:

- RMMC High Availability Web Services (HAWS)
- EDC Seamless Distribution failover to ESRI Geography Network
- Viewer Design Team and Directory Design Team plan for distributed hosting of viewer and catalog components.

[1] The arithmetic mean is 94.1%. The distribution shown in Fig 2 illustrates why the median is a more appropriate measure.

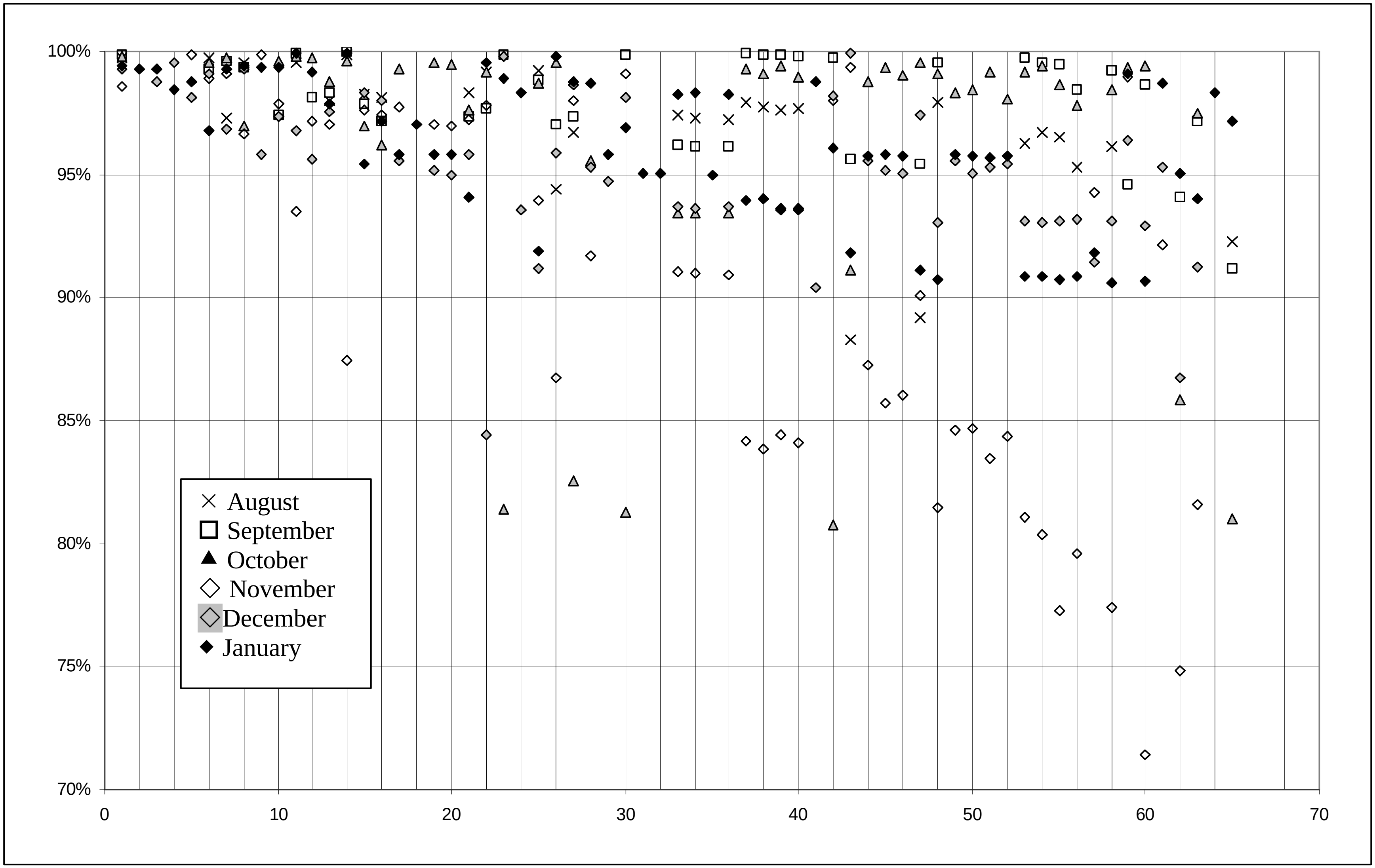


**Figure 3.** Scatter plot of service availability per month. Each vertical line is one service. Each data point is the availability of one service for one month. Data points below 70% are not shown. The services are arranged in order of decreasing average availability. The X axis values are the "rank" values in the following table.

**Table 1.** The table below contains the availability data for all services for the six months from August 2003 through January 2004. The list is ordered by overall average availability (most reliable services at the top). Null cells indicate the service was not registered in *The National Map* during that month. The 'rank' column values are the X axis values in the previous figure. The highlighted lines are two particularly important services owned by the USGS. The impacts of these two services being down are discussed in the text.

| | | Availability per cent | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Rank | Service | Aug | Sept | Oct | Nov | Dec | Jan | Avg |
| 1 | Mecklenburg Pilot (meckgeo) WMS (NC OneMap) | 0.998 | 0.998 | 0.998 | 0.986 | 0.993 | 0.994 | 0.994 |
| 2 | FS Boundaries WMS | | | | | | 0.993 | 0.993 |
| 3 | Lake Tahoe WMS (TIIMS) | | | | | 0.988 | 0.993 | 0.990 |
| 4 | Missoula County Geographic Communications Systems (GCS) | | | | | 0.995 | 0.985 | 0.990 |
| 5 | St. Louis County WMS | | | | 0.999 | 0.981 | 0.988 | 0.989 |
| 6 | Delaware WMS | 0.998 | 0.993 | 0.995 | 0.989 | 0.991 | 0.968 | 0.989 |
| 7 | MSDIS WMS | 0.973 | 0.996 | 0.997 | 0.991 | 0.969 | 0.993 | 0.987 |
| 8 | USGS Catalog WMS | 0.996 | 0.994 | 0.970 | 0.967 | 0.993 | 0.994 | 0.985 |
| 9 | Oklahoma WMS Server (GEO) | | | | 0.999 | 0.958 | 0.994 | 0.984 |
| 10 | Sedgwick County (KS) WMS | | 0.974 | 0.996 | 0.979 | 0.974 | 0.994 | 0.983 |
| 11 | TerraServer USA | 0.996 | 0.999 | 0.998 | 0.935 | 0.968 | 1.000 | 0.983 |
| 12 | York County SC WMS (NC OneMap) | | 0.981 | 0.997 | 0.972 | 0.956 | 0.992 | 0.980 |
| 13 | Henderson Co NC WMS (NC OneMap) | 0.980 | 0.983 | 0.987 | 0.971 | 0.976 | 0.979 | 0.979 |
| 14 | Tahoe Pilot WMS | 0.999 | 1.000 | 0.996 | 0.875 | 1.000 | 1.000 | 0.978 |
| 15 | USGS Greenness (NDVI) (TEST) | 0.983 | 0.979 | 0.970 | 0.976 | 0.983 | 0.955 | 0.974 |
| 16 | USGS Ref WMS (RMMC new) | 0.981 | 0.972 | 0.962 | 0.975 | 0.980 | 0.972 | 0.974 |
| 17 | Loudoun County WMS | | | 0.993 | 0.977 | 0.955 | 0.958 | 0.971 |
| 18 | Texas (TNRIS) | | | | | | 0.970 | 0.970 |
| 19 | Washington DC (CUES Region 1) WMS | | | 0.996 | 0.970 | 0.952 | 0.958 | 0.969 |
| 20 | Washington DC (CUES Region2) WMS | | | 0.995 | 0.970 | 0.950 | 0.958 | 0.968 |
| 21 | USGS NLCD60 WMS (TEST) | 0.983 | 0.974 | 0.976 | 0.973 | 0.958 | 0.941 | 0.967 |
| 22 | Wake County WMS (NC OneMap) | 0.991 | 0.977 | 0.991 | 0.978 | 0.844 | 0.995 | 0.963 |
| 23 | Kansas (RNMP-DASC) WMS | | 0.999 | 0.814 | 0.998 | 0.998 | 0.989 | 0.960 |
| 24 | Rocky Mountain National Park Pilot | | | | | 0.935 | 0.983 | 0.959 |
| 25 | Buncombe County WMS (NC OneMap) | 0.992 | 0.989 | 0.987 | 0.939 | 0.912 | 0.919 | 0.956 |
| 26 | NC OneMap WMS | 0.944 | 0.970 | 0.996 | 0.867 | 0.959 | 0.998 | 0.956 |
| 27 | Story County (IA) WMS | 0.967 | 0.974 | 0.826 | 0.980 | 0.986 | 0.988 | 0.953 |

| | | Availability per cent | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Rank | Service | Aug | Sept | Oct | Nov | Dec | Jan | Avg |
| 28 | FS Southwestern Region WMS | | | 0.955 | 0.917 | 0.953 | 0.987 | 0.953 |
| 29 | Washington DC (CUES DC Orthos) WMS | | | | | 0.947 | 0.958 | 0.953 |
| 30 | Arkansas (RNMP-CAST) WMS | | 0.999 | 0.813 | 0.991 | 0.981 | 0.969 | 0.951 |
| 31 | GNIS WMS | | | | | | 0.951 | 0.951 |
| 32 | GNIS/Atlas County Boundaries WMS | | | | | | 0.950 | 0.950 |
| 33 | Denver Pilot WMS | 0.974 | 0.962 | 0.934 | 0.910 | 0.937 | 0.983 | 0.950 |
| 34 | Utah Pilot WMS | 0.973 | 0.961 | 0.934 | 0.910 | 0.936 | 0.983 | 0.950 |
| 35 | GNIS/Atlas State Boundaries WMS | | | | | | 0.950 | 0.950 |
| 36 | Albuquerque Pilot WMS | 0.972 | 0.962 | 0.934 | 0.909 | 0.937 | 0.983 | 0.949 |
| 37 | USGS NLCD WMS (EDC) | 0.979 | 0.999 | 0.993 | 0.842 | 0.940 | 0.940 | 0.949 |
| 38 | USGS NED WMS (EDC) | 0.978 | 0.999 | 0.991 | 0.838 | 0.940 | 0.940 | 0.948 |
| 39 | USGS BTS Roads WMS (EDC) | 0.976 | 0.999 | 0.994 | 0.844 | 0.936 | 0.937 | 0.948 |
| 40 | USGS NHD WMS | 0.977 | 0.998 | 0.990 | 0.841 | 0.936 | 0.936 | 0.946 |
| 41 | FS Bankhead NF | | | | | 0.904 | 0.988 | 0.946 |
| 42 | Missouri (RNMP-MSDIS) WMS | | 0.997 | 0.807 | 0.980 | 0.982 | 0.961 | 0.946 |
| 43 | Missouri Pilot (new) | 0.883 | 0.956 | 0.911 | 0.994 | 1.000 | 0.919 | 0.944 |
| 44 | Washington DC (CUES 10m Hypso) WMS | | | 0.988 | 0.872 | 0.955 | 0.958 | 0.943 |
| 45 | Washington DC (CUES 5m Hypso) WMS | | | 0.993 | 0.857 | 0.952 | 0.958 | 0.940 |
| 46 | Washington DC (CUES 1m Hypso) WMS | | | 0.990 | 0.860 | 0.950 | 0.958 | 0.940 |
| 47 | BLM PLSS WMS (new) | 0.892 | 0.954 | 0.996 | 0.901 | 0.975 | 0.911 | 0.938 |
| 48 | USGS LANDSAT7 (EDC) WMS | 0.979 | 0.996 | 0.991 | 0.815 | 0.931 | 0.907 | 0.936 |
| 49 | Washington DC (CUES Spot Elevations) WMS | | | 0.983 | 0.846 | 0.956 | 0.958 | 0.936 |
| 50 | Washington DC (CUES Parks) WMS | | | 0.985 | 0.846 | 0.951 | 0.958 | 0.935 |
| 51 | Washington DC (CUES Buildings) WMS | | | 0.992 | 0.835 | 0.953 | 0.957 | 0.934 |
| 52 | Washington DC (CUES DC Roads) WMS | | | 0.980 | 0.844 | 0.955 | 0.958 | 0.934 |
| 53 | USGS GTOPO WMS (EDC) | 0.963 | 0.997 | 0.992 | 0.811 | 0.931 | 0.909 | 0.934 |
| 54 | Mecklenburg Pilot (Mick_Co) WMS (NC OneMap) | 0.967 | 0.995 | 0.994 | 0.803 | 0.931 | 0.909 | 0.933 |
| 55 | Charlotte WMS (National Atlas hydro) | 0.965 | 0.995 | 0.987 | 0.772 | 0.931 | 0.907 | 0.926 |
| 56 | 133 UA Ortho WMS | 0.953 | 0.985 | 0.978 | 0.796 | 0.932 | 0.908 | 0.925 |
| 57 | Buncombe Co (Aerial Photo) WMS (NC OneMap) | | | | 0.943 | 0.914 | 0.919 | 0.925 |
| 58 | Mecklenburg Pilot (Charlotte) WMS (NC OneMap) | 0.961 | 0.993 | 0.985 | 0.774 | 0.931 | 0.906 | 0.925 |
| 59 | LA (RAC -new) WMS | 0.543 | 0.946 | 0.994 | 0.990 | 0.964 | 0.991 | 0.905 |

| | | Availability per cent | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Rank | Service | Aug | Sept | Oct | Nov | Dec | Jan | Avg |
| 60 | Wash-ID Pilot WMS | 0.680 | 0.986 | 0.994 | 0.714 | 0.929 | 0.907 | 0.868 |
| 61 | FS Pike Pilot | | | 0.577 | 0.922 | 0.953 | 0.987 | 0.860 |
| 62 | MetroGIS WMS (MN) | 0.674 | 0.941 | 0.858 | 0.749 | 0.867 | 0.950 | 0.840 |
| 63 | Mecklenburg Pilot (sid01) WMS (NC OneMap) | 0.339 | 0.972 | 0.975 | 0.816 | 0.912 | 0.940 | 0.826 |
| 64 | National Park Service | | | | | 0.437 | 0.983 | 0.710 |
| 65 | Montana WMS | 0.923 | 0.912 | 0.810 | 0.013 | 0.504 | 0.972 | 0.689 |
| | | | | | | | | |
| | average | 0.921 | 0.981 | 0.956 | 0.889 | 0.937 | 0.961 | 0.941 |
| | median | 0.974 | 0.986 | 0.988 | 0.913 | 0.953 | 0.958 | 0.970 |